ABSTRACT

Images are produced to record or display useful information. Due to imperfections in the imaging and capturing process, however, the recorded image invariably represents a degraded version of the original scene. Image restoration is the problem of recovering information which is lost due to a number of reasons. This is an important problem which is encountered in numerous application, from space exploration to endoscopy, and from remote sensing to microscopy and commercial photography. To remove the degradation of images, an image restoration software is implemented using several deconvolution techniques and comparison of the results to nd the more accurate one is done. The software to restores data that has been a ected by noise. Basically the software consists of three parts: First part uses the characteristics of particular image acquisition devices, thus making ltration more accurate, second part uses the TV regularization iterative blind image restoration algorithm, the third one is the manual mode which uses the median lter and last one uses anisotropic di usion technique. The outcome of technique is compared using Image comparison, SNR comparison and Histogram analysis.

Contents

List of Figures

Abbreviations

SRS	Software Requirements Speci cation
DFD	Data Flow Diagram
GUI	Graphical User Interface
HTML	Hyper Text Mark up Language
HTTP	Hyper Text Transfer Protocol
PDF	Portable Document Format
PSF	Point Spread Function
SNR	Signal to Noise Ratio
TVRIBIR	TV Regularization Iterative Blind Image Restoration

Chapter 1

PREAMBLE

1.1 Problem de nition

In the process of image formation, transmission and recording, because of the imaging system, transmission medium and the equipment is not perfect, it makes the quality of image declined. These imperfections gives a degraded version of the original image. Processing the degraded image results in unreliable outputs.

1.2 Objective

The project titled "IPXERO" is a new approach that implements recently established image denoising techniques. The main part of this project is estimation of degradation function and image restoration. Ipxero compares output of the latest lters with that of the traditional methods. It compares the results and nds the most accurate method for image restoration.

The main objective of the project is to nd the most accurate method for image restoration. Each methodology has it's own pros and cons,the aim of this project is to nd the most accurate one among them. The software generates an estimate of the original image prior to the degradation.

1.3 Scope

This software is intended to restore images that has undergone degradation. The software will be designed to retain the clarity of information in numerous applications, from space exploration to endoscopy, and from remote sensing to microscopy and commercial photography. The software will compare and nd the perfect algorithm for high-end applications in medical and space research.

1.4 Introduction To The Project

Digital Images play an important role in our daily life requirements such as Digital Cameras, Satellite Television, Bio-medical Imaging, Astronomy and Aerospace Explo-ration, Geographical Information System etc. Image denoising is a major challenge and an applicable issue found in image processing and computer vision problems. IPXERO is an image restoration software to improve the quality of the image by dropping the degraded images back to original images by means of several ltering techniques.

Data sets collected by image sensors are contaminated by the noise. Imperfect in-struments, problems with data acquisition process, and interfering natural phenomena can all corrupt the data of interest. Thus noise reduction is an important technology in Image Analysis and the rst step to be taken before images are analysed. There-fore, Image Denoising techniques are necessary to prevent this type of corruption from digital images. Noise can also be introduced by transmission errors and compression. The image can be loaded from any existing directory from the system. After fetching image to the system, it analyses the input and selected ltering technique is applied to the image. The Signal to Noise Ratio graph and Spectral analysis of resulting image is done. The system also provides the user an option to compare result using SNR.

Chapter 2

SYSTEM STUDY

2.1 Introduction

2.1.1 Purpose

The purpose of this document is to present a detailed description of the Image restora-tion software. It will explain the purpose and features of the software, the interfaces of the software, what the software will do, the constraints under which it must operate. This document is intended for both the stakeholders and the developers of the software and will be proposed to the committee for its approval.

2.1.2 Document Convention

All system development activities should follow the nal version of this document. Any discrepancy that found during in later phases should be modi ed subject to SRS. However, this document may be subjected to change depending on the decision of the group members. The typographical conventions used :

a) Main headings: Font=Times New Roman, Bold, Size=20.

b) Headings: Font=Times New Roman, Bold, Size=16.

c) Sub headings: Font=Times New Roman, Bold, and Size=14

d) Body text: Font=Times New Roman, Size=12.

e) Header & Footer { Font Size: 10, Bold & Italics, Times New Roman. The document contains header on all pages. The header is the name of the project on top left end and page number on the top right end of the page.

f)Bullets are used to denote main points in the section.

2.1.3 Intended Audience and Reading Suggestions

This document contains general information on Ipxero, functions, features and special technologies. This document is intended for:

Developers: In order to be sure they are developing the right project that ful lls requirements provided in this document.

Testers: In order to have an exact list of features and functions that have to respond according to requirements and provided diagrams.

Users: In order to get familiar with the idea of the project and suggest other features that would make it even more functional.

2.2 Overall Description

2.2.1 Product Perspective

In an increasingly digital world, Digital Images play an important role in day to day applications such as Digital Cameras, Magnetic Resonance Imaging, Satellite Televi-

sion as well as in areas of research and technology including Geographical Information System. Generally, data sets collected by image sensors are contaminated by noise. Imperfect instruments, problems with data acquisition process, and interfering natural phenomena can all corrupt the data of interest. Thus noise reduction is an important technology in Image Analysis and the rst step to be taken before images are ana-lyzed. Therefore, Image De-noising techniques are necessary to prevent this type of corruption from digital images. Noise can also be introduced by transmission errors and compression. This software provides di erent methodologies for noise reduction. It also gives us the insights into the methods to conclude which method will provide the consistent and approximate estimate of original image from given its degraded version.

2.2.2 Product Functions

The following are the product functions of Ipxero:

Software provides various ltering techniques for de-noising.

By selecting options on the lter menu further operations are performed. User can change the threshold value of Median lter.

User can add device pro les in Auto pro ling mode.

Software imparts provision to compare de-noised images using di erent approaches.

2.2.3 User Classes and Characteristics

The system is mainly focused in scienti c areas such as satellite television, Intelligent tra c monitoring, handwriting recognition on checks, signature validation, computer resonance imaging and in area of research and technology such as geographical infor-mation systems and astronomy. It can also be used for commercial photography and other purposes.

Research purposes: Scientists uses TVRIBIR lter and Anisotropic di u-sion technique for biomedical imaging, astronomical and aerospace exploration, geographical information system etc.

Commercial photographers: In the eld of photography, the degradation caused by the acquisition technique and color misbalancing can be restored by Median lter.

Ordinary users: Users who are unaware of ltering techniques and speci cations can use Auto pro ling.

2.2.4 Operating Environment

Software requirements: Software is supported by Windows (versions 7/8/8.1/10) and Linux operating systems. It works on x86-64 platform. Supporting software required are Matlab runtime complier and Java Runtime Environment.

Hardware requirements: Software runs on Intel i3, i5, i7 and Pentium processors. Supporting software required are Matlab runtime complier and Java Runtime Environment.

2.2.5 Design and Implementation Constraints

The software uses saved pro les for Auto pro ling. When a new acquisition device is used, then their pro le should be added at the developer level. The software requires Matlab runtime compiler (version above Matlab R2015a) for the execution. If the customer organization encounters any problem, it could be reported to the developer for further recti cation. The software requires 64-bit Operating System.

2.2.6 User Documentation

Software has user manuals, online help and tutorials that are delivered along with the package. The user manuals will be provided in PDF format and online help will be in

HTML.

2.2.7 Assumptions and Dependencies

In Auto pro le methodology, we assume that the name of the acquisition device is available with the image. If not, then this mode cannot be used. Ipxero should be compatible with most of the operating system i.e., previous and latest ones.

2.3 External Interface Requirements

2.3.1 User Interfaces

Ipxero use Matlab GUI standards. It has Menu bar which consists of File, Edit, Filter, Pro le, View and Helps options. It has a separate toolbar which consist of Editing, Plotting and Luminosity adjustment tools.

2.3.2 Hardware Interfaces

The external hardware interface used for accessing Ipxero is the personal computers of the user. It supports plug-and-play feature so that the images can be loaded directly from plugged-in device. Ipxero bears Matlab supported image formats.

2.3.3 Software Interfaces

Ipxero uses Matlab R2015a runtime compiler as supporting tool. The data items are loaded as images into the system. The data sharing mechanism must be in global area.

2.3.4 Communications Interfaces

Ipxero provides online help service which uses HTML webpage. Communication stan-dard used in webpage is HTTP.

2.4 System Features

The system contains several features such as Image Fetching, Image De-noising and Comparison.

2.4.1 Image Fetching and Analysis

Description and Priority

The user should be able to easily load an image into the system. The image can be loaded from any existing directory from the system. The input image is then analyzed by the system. This task is of low priority.

Stimulus/Response Sequences

After fetching image to the system, it analyses the input. When the analysis phase is completed the system ask user to select restoration technique.

Functional Requirements

1. Image must be present in the system or in plugged in device.

2.4.2 Image De-noising

Description and Priority

Selected ltering technique is applied to the image. This feature has high priority. The system suggests that, di erent ltering techniques for di erent application domains.

Stimulus/Response Sequences

Auto pro ling: System detects the acquisition device, and noise pro le is automatically generated. When gives con rmation to proceed, ltering is done.

If the system cannot detect the acquisition device, proper messages are provided for further progress.

Anisotropic di usion: When the user a rms, the ltering is done using pre-de ned technique.

TVRIBIR lter: When the user a rms, the ltering is done using pre-de ned technique.

Median lter: When the user a rms, the ltering is done using pre-de ned technique.

Functional Requirements

1. The information about the acquisition device should be known.

2.4.3 Comparing Results

Description and Priority

The Signal to Noise Ratio graph and Histogram analysis of resulting image is done. This feature has medium priority.

Stimulus/Response Sequences

The system provides the user an option to compare result using SNR and Histogram analysis. Based on the user's choice plotting is done and output is displayed.

2.5 Other Nonfunctional Requirements

2.5.1 Performance Requirements

The image requires a minimum of 640* 480 pixels. The performance of the system depends on the PSF present in the input image. As the speci cations of acquisition devices are updated, the changes should be re ected on the pro les.

2.5.2 Safety Requirements

The output image should be saved as copy of the original le. System should not overwrite the original image.

2.5.3 Security Requirements

The information present in the image should not be lost while de-noising.

2.5.4 Software Quality Attributes

1. Planned approach towards working: The working in the system will be well planned and organized. The image will be stored properly.

2. Accuracy: The level of accuracy in the proposed system will be higher. All operation would be done.

3. Reliability: The reliability of the proposed system will be high due to the above stated reasons. The reason for the increased reliability of the system is that now there would be proper storage of information.

4. No Redundancy: In the proposed system utmost care would be that no information is repeated anywhere, in storage or otherwise. This would assure economic use of storage space and consistency in the data stored.

5. Easy to Operate: The system should be easy to operate and should be such that it can be developed within a short period of time and t in the limited budget of the user.

Chapter 3

SYSTEM DESIGN AND MODELING

3.1 Design Methodologies

System design is the process of developing speci cations for a candidate system that meet the criteria established in the system analysis. Major step in the system design is the preparation of the input forms and the output reports in a form applicable to the user.

The main objective of the system design is to use the package easily by any computer operator. System design is the creative act of invention, developing new inputs, a database, o ine les, method, procedures and output for processing business to meet an organization objective. System design builds information gathered during the sys-tem analysis.

In design an e cient and e ective system is of great importance to consider the human factor and equipment that these will require to use. System analyst must evaluate the capabilities and limitations of the personal and corresponding factors of the equipment itself. The characteristics associated with e ective system operation are accessibility, decision making ability, economy, exibility, reliability and simplicity.

We have followed the waterfall model. It is the simplest process model which states

that the phases are organized in linear order. One of the main advantages of the model is its simplicity. It is conceptually straight forward and divide the large task of building a software system into a series of cleanly divided phases.

Waterfall model is the most widely used process model. It is well suited for routine type of projects where the requirements are well understood. That is, if developing organization is quite familiar with the problem domain and the requirements for the software are quite clear, the water fall model works well.

3.2 System Architecture

The main components of the system include a pc which runs the application that per-forms the denoising techniques and compares the resultant outputs and a hard disk to fetch input image for processing and save the output.

The system consist of three modules: Image fetching & analysis module, De-noising module and comparison module. In image fetching and analysis module, the user is able to easily load an image into the system. The image can be loaded from any existing directory of the system and is then analyzed. When the analysis phase is completed the system ask user to select restoration technique. In de-noising module, the selected ltering technique is applied to the image. There are four de-noising tech-niques: Auto-pro ling, Anisotropic di usion, TVRIBIR lter and Median lter. For comparing the results, Signal to Noise Ratio graph and Histogram analysis is done.

The user is able to easily load an image into the system. The image can be loaded from any existing directory and plugged in devices.The input may be of types: JPG, JPEG, PNG and BMP. After fetching, input image is analysed to study its properties. The user selects denoising technique and it is applied to input image.

In auto pro ling, the system provides several device noise pro les. The pro les are created from developer end. the properties of noise produced by the corresponding device is required to create the device noise pro les. Once created, it is reuseable for various imaging devices. The user can select appropriate pro le for denoising based on the speci cs of acquisition device. The noise lter processes images to accurately

reduce noise and fully preserving details that may be present.

Anisotropic di usion technique utilizes a di usion function based on tangent sigmoid function. A local edge indicator function is also used to reduce the noise and detection of edges in digital images. Di usion models are used for image smoothing of noisy images. It uses a non linear PDE model along with a new di usion coe cient to favor the smoothing of images in homogeneous regions and preservation of edges and con-tents.

Di usion function for the anisotropic di usion allows an opportunity to reduce noise without perturbing the signi cant contents of the image, during the di usion process. To reduce the over smoothing of the image, a high pass lter added with initial data before di using the image with system. The same lter can be used to improve the contrast, preserve high frequency content and reduces blur in the image simultane-ously.

TVRIBIR is a kind of blind image restoration method, the total variation regular-ization and iterative blind deconvolution is combined. TV regularization blind image restoration algorithm has low computational complexity and recovery e ect is good. Under the unknown PSF cases, we achieved good recovery e ect, but it also has the presence of noise ampli cation and ringing phenomenon. Iterative blind deconvolution method has the characteristics of small amount of calculation, and the algorithm is simple, so it is widely attention to rapid development. TVRIBIR lter can overcome poor e ect of traditional regularization blind restoration methods to complex fuzzy type or a complex image restoration, and poor reliability of iterative blind deconvolu-tion. The uniqueness of solution and convergence is di cult to determine, the solution is unstable and other shortcomings. It can quickly access high quality of restored im-age, and be able to recover for multiple fuzzy type.

The median lter is a nonlinear digital ltering technique, often used to remove noise from an image. Such noise reduction is a typical pre-processing step to improve the results of later processing. Median ltering is very widely used in digital image pro-cessing because, under certain conditions, it preserves edges while removing noise, also having applications in signal processing. A good lter will reduce noise and preserve the edges. It is particularly e ective at removing `salt and pepper' type noise. The median lter works by moving through the image pixel by pixel, replacing each value with the median value of neighbouring pixels. The pattern of neighbours is called the

"window", which slides, pixel by pixel over the entire image pixel, image. The median is calculated by rst sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixel value.

Median lter is a non-linear lter and it is used to remove impulse or salt and pep-per noise from images. Impulse noise can take any value from 0 and 255 randomly. Impulse noise occurs due to a random bit error in communication channel. The basic principle of the median lter is that the entire signal is send entry by entry and then replaces each entry with the median of the neighbouring entries. In median ltering, a de nite size window slides along full image and the median intensity value of the pixels within the window becomes the output intensity of the pixel being processed. The lter uses one threshold for ltering. If the intensity di erence between the centre pixel value and median value in the window is greater than the threshold then centre pixel is replaced by median values otherwise centre pixel will remain unchanged. The window size can be 3x3, 5x5 etc Median lter is used to denoise images and also some sort of edges are preserved.

The output from various ters are compared using SNR and Histogram analysis. The signal-to -noise ratio(SNR), is used in imaging as a physical measure of sensitivity of a imaging system. The SNR values of resulting images are calcluated and is compared with one another. That is, Anisotropic di usion vs Median 2D lter and TVRIBIR lter vs Median 3D. Histogram a graphical representation of the distribution of nu-merical data. It is an estimate of probability distribution of continuous variable. It is a bar graph. In the system, histogram analysis of anisotropic di usion and TVRIBIR lter is done.

3.3 Data Flow Diagram

A data- ow diagram (DFD) is a graphical representation of the " ow" of data through an information system. DFDs can also be used for the visualization of data processing (structured design). On a DFD, data items ow from an external data source or an internal data store to an internal data store or an external data sink, via an internal process.

A DFD provides no information about the timing or ordering of processes, or about whether processes will operate in sequence or in parallel.

It is therefore quite di erent from a owchart, which shows the ow of control through an algorithm, allowing a reader to determine what operations will be performed, in what order, and under what circumstances, but not what kinds of data will be input to and output from the system, nor where the data will come from and go to, nor where the data will be stored (all of which are shown on a DFD).

1. It shows the ow of data in the system.
2. The processes within the system
3. The data stores les that supports the system's operation.
4. The information ows within the system
5. The system boundary
6. Interactions with external entities

General principle in data ow diagramming is that a system can be decomposed into subsystems and subsystems can be decomposed into lower level subsystems and so on. Each subsystem represents a process or activity in which data is processed. At the lowest level, processes can go longer be decomposed. Just as a system must have input and output, a process must also have input and Data enters the system from the environment; data ows between processes within the system; and data is produced as output from the system.

3.3.1 Level 0 DFD

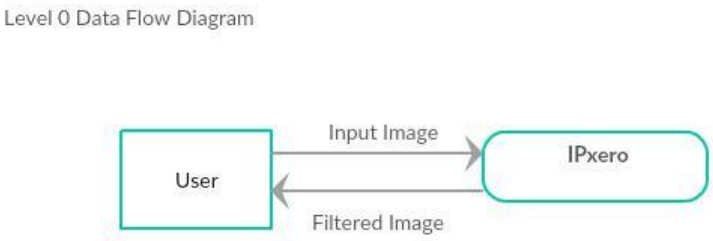

Figure 3.1: Level 0 DFD

3.3.2 Level 1 DFD

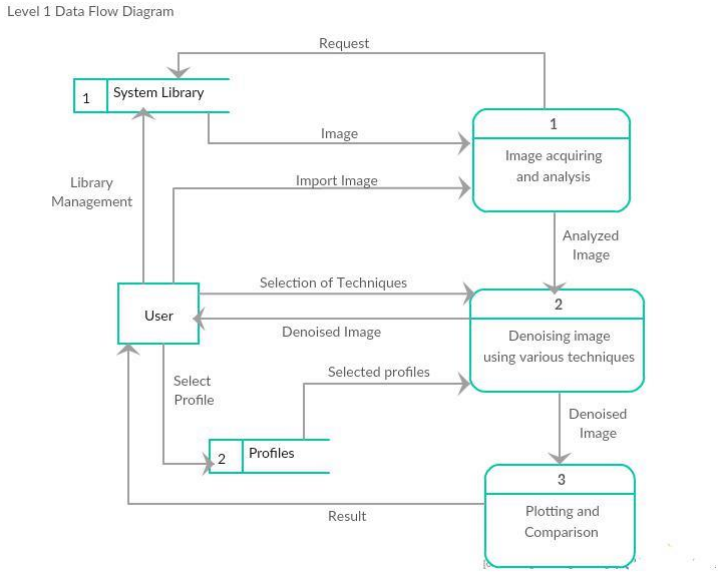

Figure 3.2: Level 1 DFD

3.3.3 Level 2 DFD

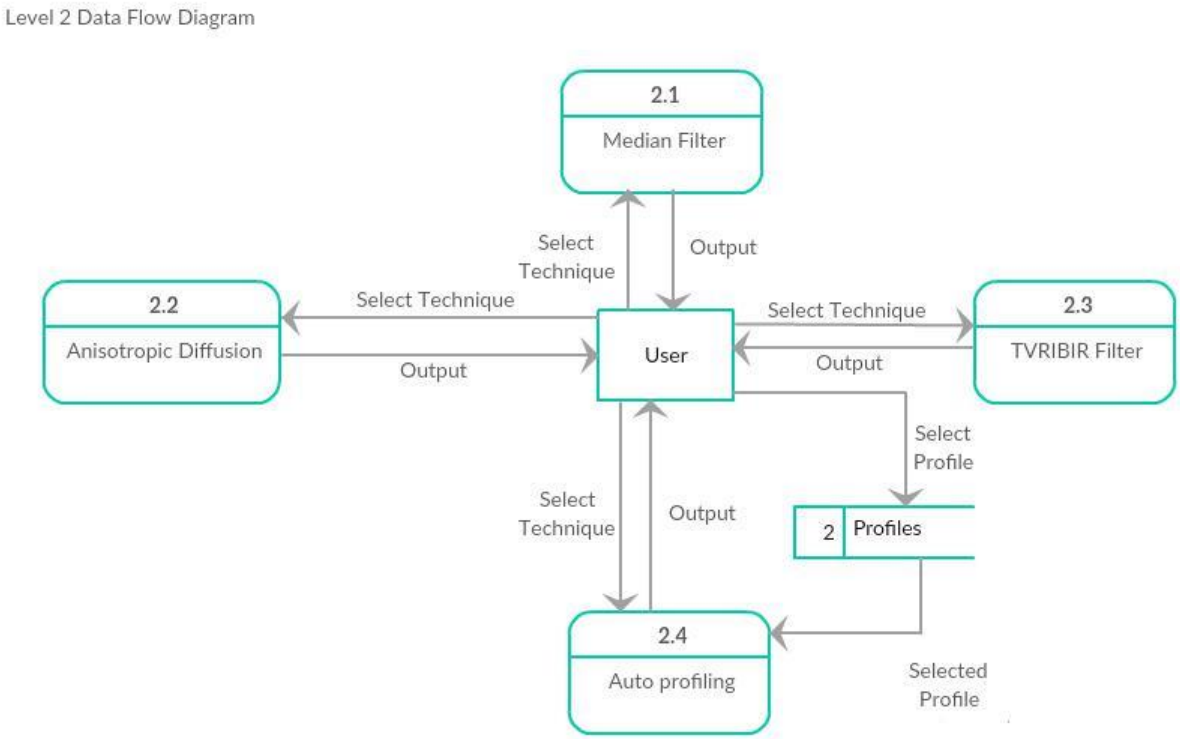

Figure 3.3: Level 2 DFD

3.4 Use Case Diagram

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the di erent use cases in which the user is involved. A use case diagram can identify the di erent types of users of a system and the di erent use cases and will often be accompanied by other types of diagrams as well.

In usecase diagram the actors and di erent cases are speci ed. This system has only one actor, user. The use cases in the system are: Acquiring image, analyzing image, denoising input image, comparison and display results.

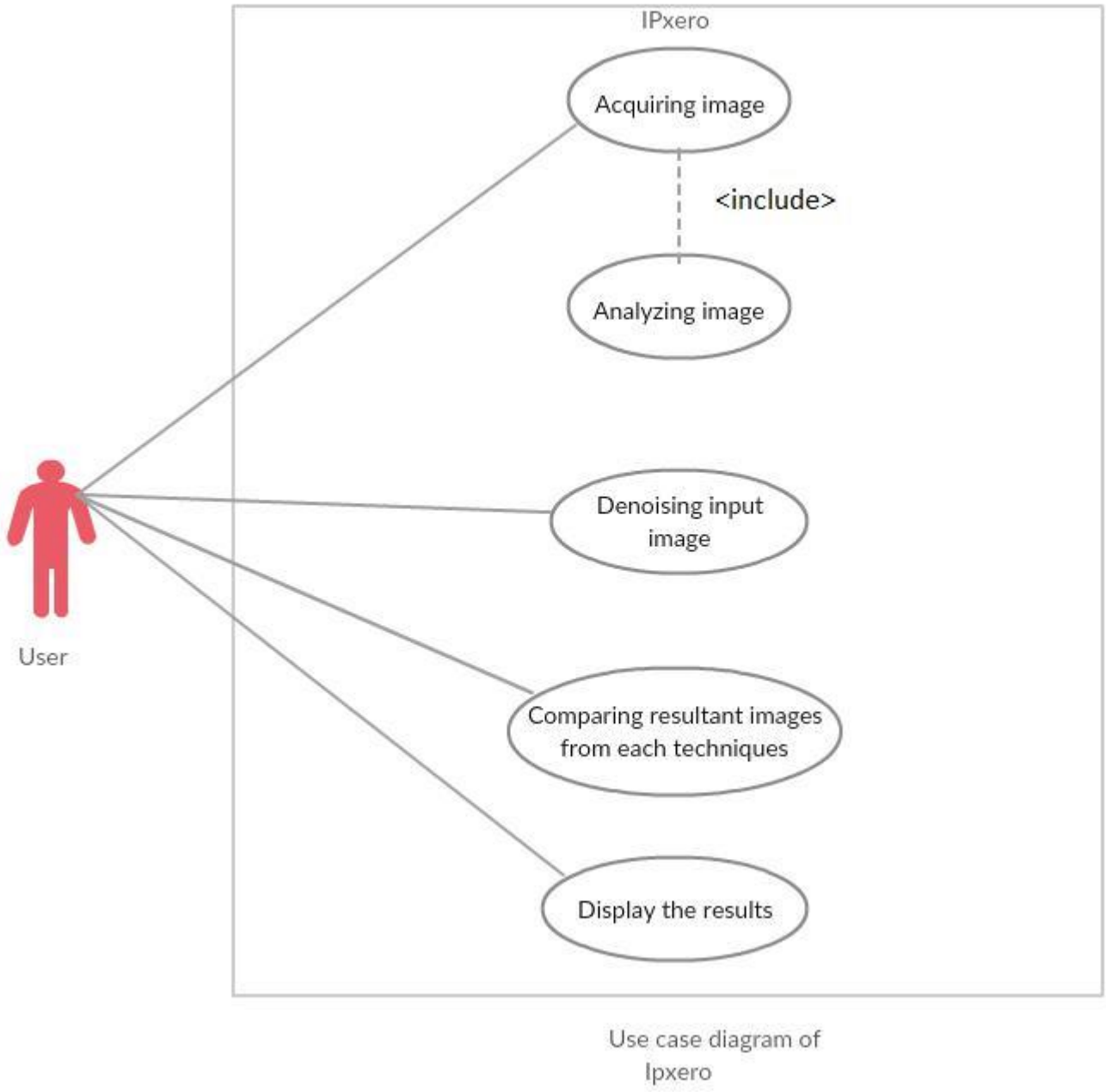

Figure 3.4: Use case diagram

Chapter 4

IMPLEMENTATION

4.1 Introduction

Implementation is the stage in the project where the theoretical design is turned into a working system and is giving on the new system for the users that it will work e ciently and e ectively. It involves careful planning, investigation of the current system and its constraints on implementation, design of methods to achieve the changeover, an evaluation, of change over methods.

Apart from planning major task of preparing the implementation are education and training of users. The more complex system being implemented, the more involved will be the system analysis and the design e ort required just for implementation. An implementation coordinating committee based on policies of individual organization has been appointed.

The implementation process begins with preparing a plan for the implementation of the system. According to this plan, the activities are to be carried out, discussions made regarding the equipment and resources and the additional equipment has to be acquired to implement the new system. .

4.2 Implementation Plan

Implementation is the nal and important phase. The most critical stage in achieving a successful new system and in giving the users con dence that the new system will work and be e ective. The system can be implemented only after thorough testing is done and if it found to working according to the speci cation.

The primary purpose behind the development of image restoration software is to re-cover the information lost due to degradation. Because images are produced to record useful and important information. In contrast to conventional softwares which uses traditional methods, we use latest restoration techniques for restoration.

The system can fetch input image from storage or any plugged-in devices. The input may be of types: JPG, JPEG, PNG and BMP. Ipxero provides various ltering tech-niques for denoising and lets the user to select one among them. Further operations can be done only after choosing the lter. User can choose various lters for denoising and can compare the results with one another.

Ipxero contains four ltering techniques. Each denoising technique is implemented sep-arately and is integrated together along with basic image editing tools. The comparison techniques are implemented next. The comparison module contains two techniques: SNR comparison and Histogram. Each technique is implemented separately and is integrated together to complete this module.

Ipxero compares the outputs to nd the most accurate lter. The system also provides some pre-de ned pro les for various image acquisition devices. The pro le contains denoising functions corresponding to each acquisition devices.

Auto pro le technique denoise the input image based on device speci ed by the user. The device noise pro les will be created based on the properties of noise caused while capturing the image. Pro les will be created from developer end. Once created, it is reuseable for various imaging devices.

The user can select appropriate pro le for denoising based on the speci cs of acqui-sition device. The noise lter processes images to accurately reduce noise and fully preserving details that may be present.

In Anisotropic di usion, at rst the partial di erential equation at initial condition of the input image is calculated. Then the central pixel values and nite di erences are

found. The di usion technique is applied and discrete PDE solution is found.

In TVRIBIR lter, intially salt and pepper noise is added to the input image. Then a PSF is applied to the noisy image and is blurred by means of circular convolution. This blurred image is the input for next phase of restoration. Blind deconvolution is performed on blurred image and is restored. Colormapping is done to restore the color of image and it is nally reconstructed.

The system implements both median 2D and median 3D lters to obtain denoised output in grayscale and RGB respectively. In case of median 2D, the original image should be converted to grayscale and median 2D function is applied. The input image is converted into 3D array and median ltering is applied.

Chapter 5

TESTING

5.1 Introduction

Testing is the process of executing a program with the indent of nding any errors .A good test of course has the high probability of nding a yet undiscovered error. A suc-cessful testing is the one that uncovers a yet undiscovered error. A test is vital to the success of the system. System test makes a logical assumption that if all parts of the system are correct, then goal will be successfully achieved. The candidate system is subjected to a variety of tests online like responsiveness, its value, stress and security. A series of tests are performed before the system is ready for user acceptance testing. The success of testing in revealing errors depends on the test cases. Testing should help locate errors, not just detect their presence. Test should be organized in a way that helps isolate errors.

Thus testing should be considered only one of the means to analyze the behavior of a system and should be integrated with other veri cation techniques in order to enhance our con dence in system qualities as much as possible.

System testing of software or hardware is testing conducted on a complete,integrated system to evaluate the system compliance with its speci ed requirements. System testing falls within the scope of black box testing, and as such, should require no knowledge of the inner design of the code or logic.

Black-box testing is a method of software testing that tests the functionality of an

application as opposed to its internal structures or workings. Speci c knowledge of the application's code/internal structure and programming knowledge in general is not required. Test cases are built around speci cation and requirements, i.e., what the application is supposed to do. It uses external descriptions of the software, including speci cation, requirements, and designs to derive test cases. These tests can be func-tional or non-functional, though usually functional.

The test designer selects valid and invalid inputs and determines the correct output. There is no knowledge of the test object's internal structure. This method of test can be applied to all levels of software testing: unit, integration, functional, system and acceptance. It typically comprises most if not all testing at higher levels, but can also dominate unit testing as well.

5.1.1 Unit testing

In unit testing di erent modules are tested against the speci cation produced during the design of modules. Unit testing is essential for veri cation during coding phase. The aim is to test the internal logic of the modules. The tests carried out during the programming stage itself.

This enables the tester to detect errors in coding and logic that are contained within that module alone. Those resulting from the interaction between modules are initially avoided. Unit test comprises the set of performed prior to integration of the unit in to the entire project. Four categories of tests are performed on each unit.

Functional test: The code is exercised with normal input values for which the ex-pected results are shown, as well as boundary values and values on and just outside the functional boundaries and special values such as logically related inputs.

Performance Test: Performance test is done to determine the amount of execution time spent in various parts of the unit, program throughput and response time and device utilization by the program unit.

Stress Test: Stress test intentionally breaks the unit. This helps in learning about the strength and limitations of the program by examining the manner in which a pro-gram unit breaks.

Structure Test: Structure tests are used to test the internal logic of a program. The

major activity involved in this is to decide which paths to exercise, deriving test to exercise those paths, determining the test coverage criteria to be used.

5.1.2 Integration Testing

Integration testing focuses on the design and the construction of the software archi-tecture. The data can be lost across the interface or one module can pose an adverse e ect on another. The sub functions when combined may not produce the major func-tion. Integration testing is a systematic technique for the program structure, while at the same conducting test to uncover errors associated with the interface. In this test, groups of the program modules are tested together to determine if they interface properly. Two types of integration testing are:

Top down Integration: This method is an incremental approach to one construction of program structure. Modules are integrated by moving downward through the con-trol hierarchy, beginning with the main program module. The modules subordinates to the main program module are incorporated into the structure in either a depth rst or breadth rst manner.

Bottom up Integration: This method begins the construction and testing with the modules at the lowest level in the program structure. Since the modules are integrated from the bottom up, processing required for modules subordinate to a given level is always available and the need for the stubs is eliminated.

5.1.3 System Testing

System testing is a critical element of quality assurance and represents the ultimate review of analysis, design and coding. When a system is developed it is hoped that it performs, manual procedures, computer operations and control.

System testing is the process of checking whether the developed system is working ac-cording to the objective and requirement. All testing accordance to the test conditions speci ed earlier. This will ensure that the test coverage meets the requirements and that testing is done in a systematic manner.

In system testing we check whether the integrated system works according to the

objectives.

5.2 Test cases

A test case in software engineering is a set of conditions or variables under which a tester will determine whether an application or software system is working correctly or not. It is the mechanism for determining whether an application or software system is working correctly or not. The mechanism for determining whether a software program or system has passed or failed such a test is known as a test oracle. In some settings, an oracle could be a requirement or use case, while in others it could be a heuristics. It may take many test cases to determine that a software program or system is functioning correctly. Test cases are often referred to as test scripts, particularly when written. Written test cases are usually collected into test suites.

5.2.1 Project Test cases

TVRIBIR lter testing

The TVRIBIR is tested by removing the noise in the degraded image by using decon-volution method.

Positive Test case:

Degraded image is restored to it's absolute original form.

Negative Test case:

SNR value of the restored image is less than the image restored by anisotropic di usion.

Anisotropic di usion testing

The Anisotropic di usion technique is tested by removing the noise by preserving its edges.

Positive Test case:

{ Noisy image is restored successfully and edges are preserved by intra region smoothening.

{ SNR value is greater compared to TVRIBIR.

Negative Test case:

Output is obtained in Grayscale for color input.

Chapter 6

CONCLUSION

6.1 Advantage of Project

The main advantages of our project are as follows:

More accurate results are obtained.

Can compare the output of various denoising lters.

User can choose pro les corresponding to the acquisition device. Ease of recruitment.

No confusing procedure.

6.2 Disadvantages of Project

While using anisotropic di usion, output is obtained in Grayscale for color input. No provision to add pro les from user end.

Threshold values for ltering techniques cannot be altered by user. Good system support is needed.

6.3 Future Scope

The application developed is designed in such a way that any further enhancement can be done with ease. The system has the capability for easy integration with other systems. New modules can be added to the existing system with less e ort. The application proves better extensiblity and exibility for future enhancements. Any further requirement application is possible with the same features guaranteed. The future developments that can be suggested are:

1. Allow user to add/remove/edit pro les in the software.
2. More ltering techniques can be integrated.
3. More image editing tools can be added
4. User account mode can be added along with the public mode.

REFERENCES

[1] [IEEE Standard 181-1998]: The standard followed by the current SRS

[2] Roger.S.Pressman, Software Engineering: A Practitioner's Approach, McGraw Hill International edition, Seventh edition.

[3] Subit K Jain and Rajendra K Ray. An Alternative Framework of Anisotropic Diffusion for Image Denoising, ACM March 05,2016

[4] Keyong Shao, Yun Zou, Yuanhong Liu, Cheng Li, Bosi Fu. TV Regularization Iterative Blind Image Restoration algorithm IFSA Sensors and Transducers, Vol. 167 Issue 3, March 2014

[5] Devesh Bhalla, Anjana Goen. Noise Detection Chromatic Median Filter for Denois-ing Digital Color Image, International Journal of Advanced Research in Computer Science and Software Engineering, December 2015